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Assignment : no 1

Subject : Digital Logic Design

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Q1: what is the weight of 7 in 1799_{10}?

Sol:

writing in weight form

$(1 \times 10^3) + (7 \times 10^2) + (9 \times 10^1) + (9 \times 10^0)$

$1000 + 700 + 90 + 9$

The weight of 7 in 1799_{10} is 100.

Q2 Give the value of each digit in $(5436)_{10}$?

Sol: write in weighted form

$(5 \times 10^3) + (4 \times 10^2) + (3 \times 10^1) + (6 \times 10^0)$

500 400 30 6

value of 5 = 5000
value of 4 = 400
value of 3 = 30
value of 6 = 6

Q3:- Convert the following.

(a) $11111111_{(2)} = (?)_{10}$

Sol Using weighted notation

$(1\times10^{7}) + (1\times10^{6}) + (1\times10^{5}) + (1\times10^{4}) + (1\times10^{3}) + (1\times10^{2}) + (1\times10^{1}) + (1\times10^{0})$

128 64 32 16 8 4 2 1

255_{10} Ans

(b) $187_{10} = (?)_{2}$

Sol:- Using Repeated division by 2.

2	187	0
2	63	−1
2	31	−1
2	15	−1
2	7	−1
2	3	−1
	1	−1

$= (01111111)_2$ Ans

(c) $45.25_{(10)} = (?)_2$

Sol:- Using Repeated division for whole number 45

2	45	
2	22	-1
2	11	-0
2	5	-1
2	2	-1
	1	-0

$45_{10} = 101101_2$

Using repeated multiplication for decimal part:

$0.25 \times 2 = 0.50 \rightarrow 0$

$0.50 \times 2 = 1.00 \rightarrow 1$

$= 45.25_{(10)} = (101101.01)_2$

(d) $10000000.1010_{(2)} = (?)_{10}$

Sol:- Using weighted notation (ignoring O_2)

$(1 \times 2^7) + (1 \times 2^{-1}) + (1 \times 2^{-3})$

$128 + 0.5 + 0.125$

$= 128.625_{(10)}$ Ans.

(e)

$4D7F_{(16)} = (?)_{10}$

Sol:- Using weighted notation

$(4\times16^3) + (13\times16^2) + (7\times16^1) + (15\times16^0)$

$16384 + 3328 + 112 + 15$

$(19839)_{10}$ Ans

(f)

$198_{(10)} = (?)_{16}$

Sol:- Using Repeated division by 16

$16 \mid 198$

$\quad\;\; 8 \cdot 0$

$198_{(10)} = 80_{16}$ Ans

(g) $3A6F_{(16)} = (?)_2$

Sol:- by hex – Binary table

3	A	6	F
0011	1010	0110	1111

$= 0011101001101111_{(2)}$

(Ans)

(h)

$1100001111100101_{(2)} = (?)_{16}$

Sol:

Using groups of four.

1100	0011	1110	0101
C	3	E	5

$= C3E5_{(16)}$ (Ans)

(i) $6173_{(8)} = (?)_{10}$

Sol:

Using weighted notation.

$(6 \times 8^3) + (1 \times 8^2) + (7 \times 8^1) + (3 \times 8^0)$

$3072 + 64 + 56 + 3$

$61783_{(8)} = 3195_{(10)}$ (Ans)

(j) $169_{(10)} = (?)_8$

Sol:

8	169
8	21 -1
	2 -5

$(251)_8$ (Ans)

(K)

$3740_{(8)} = (?)_2$

Sol.

Using Oct - Binary table

3	7	4	0
011	111	100	000

$011111100000_{(2)}$ (Ans)

(L) $101011000101111_{(2)} = (?)_8$

Sol:

Using Groups of 3

001	010	110	001	011	111
1	2	6	1	3	7

$= 126137_{(8)}$ (Ans)

(M) $2A7D_{(16)} = (?)_8$

Sol:

first using hex - Binary table

2	A	7	D
0010	1010	0111	1101

Now using groups of 3.

(h) $(7503)_8 = (?)_{16}$

Sol:

Octal – Binary table first

7	5	0	3
111	101	000	011

Now using groups of 4

F	4	3
1111	0100	0011

$F43(11)$ (Ans)

b) $11111111_{(2)} = \pm (?)_{10}$

Sol:

Using 2's Complement

$$\begin{array}{r} 11111111 \\ +\ 00000000 \quad \text{1's Complement} \\ \hline 1 \quad \text{2's Complement} \\ \hline 00000001 \end{array}$$

Now since signed bit is zero

$(1)_2 = +1_{(10)}$

(Ans)

(P) $-12_{10} = (?)_2$

Sol:

First finding 12 in binary

2	12	
2	6	0
2	3	0
	1	1

$12 = 1100_{(2)}$

Taking 2's Complet

$$\begin{array}{r} 00001100 \\ 11110011 \text{ is Complent} \\ + \quad\quad 1 \text{ 2's Complent} \\ \hline 11110100_{(2)} \end{array}$$

(Ans)

(Q) $156_{(10)} = (?)_{BCD}$

Sol

Using Deci-BCD table

1	5	6
0001	0101	0110

000101010110_{BCD}

(Ans)

;

(s) 1000 0111 0000 BCD = (?)10

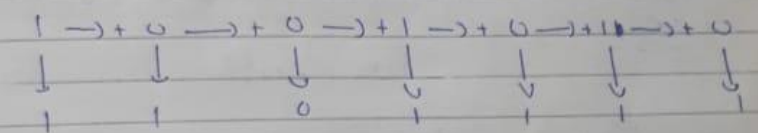
Sol:- Using BCD - Dec table

1000 0111 0000
8 7 0

870(10) Ans

(s) 1001010(2) = (?) Gray

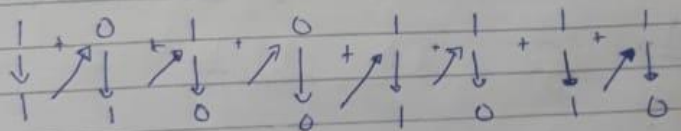
Sol:-



= 1101111 Gray (Ans)

(t) 10101111 Gray = (?)2

Sol:-



1100101 0 (2) (Ans)

(u)

Sol:- 0100 0001 = (?) ASCII - Small

Using ASCII table

$(1 \times 2^6) + (1 \times 2^0)$

64 + 1

65(10)

65(10) = A ASCII Character.

(v) 0110 0000 = (?) ASCII Capital

Sol:

Using ASCII table

$(1 \times 2^6) + (1 \times 2^5)$

$64 + 32$

$= 96_{(10)}$

$96_{(10)}$ = (`) ASCII

(w) 111000 = (? 111000) Even Parity

Sol:- For Even Parity

101101 = (1 111000) Even Parity

As the number of 1s must be even.

(x) 101101 = (? 111000) odd Parity

Sol:- For odd Parity

101101 = (1 101101) odd Parity

As number of ones must be odd.

Q4: Calculate each of the following:

(a) $1111011_{(2)} + 01011111_{(2)}$

Sol:

```
  1 1 1 1 0 1 1
+ 0 1 0 1 1 1 1 1
-----------------
1 0 1 0 1 0 0 1 0
```

Discarded bit

$01010010_{(2)}$ Ans

(b) $10000000 - 01111111$

Sol:

Taking 2's Complement

```
  0 1 1 1 1 1 1 1
+ 1 0 0 0 0 0 0 0   1's Complement
-----------------   2's Complement
  1 0 0 0 0 0 0 1
```

Now

```
  1 0 0 0 0 0 0 0
+ 1 0 0 0 0 0 0 1
-----------------
1 0 0 0 0 0 0 0 1
```

Discarded bit

00000001

Ans

(c)

$1100_{(2)} \times 11_{(2)}$

Sol:

```
   x11
    1100
   ----
    00
   00
  ·111
  ----
  100100        Ans
```

(d) $1100_{(2)} \div 10_{(2)}$

Sol:

```
      110
   ----
10 ) 1100
     10
     ---
      100
      10
      ---
       00
       00
       --
        x      (110) Ans
```

(e)

$01111111_{(2)} - 00000111_{(2)}$

Sol: Taking 2's Complement

```
  00000111
+ 11111000
  --------
         1   2's Complement
  --------
  11111001   2's Complement
```

Now

```
  01111111
+ 11111001
  --------
 101111000
```

Discard b.t

$01111000_{(2)}$ Ans

(f) $01101010_{(2)} \times 11110001_{(2)}$

Sol.

Taking 2's Complement

```
  11110001
  00001110   1's Complement
+        1   2's Complement
  00001111
```

Now

```
  00001111
  01101010
  --------
  00000000
  00011111
  00000000
  00011111
  00000000
  00011111
  00000000
  00011111
  --------
  00001010
```

Taking 2's Complement again

```
  11110110
  00001001   1's Complement
+        1   2's Complement
  --------
  00001010
```

$11110101_{(2)}$ Ans

(9)

$10001000_{(2)} \div 00100010_{(2)}$

Ans:

Taking 1's Complement

00100010

11011101 1's Complement

+ 1 2's Complement

11011110

Quotient = 00000000

Subtracting devisor from divident with 2's Compliment

+10001000

11011110

Discard → 101100110

Add 1 to quotient = 00000001

Subtracting devisor from first partial remainder

01100110

+11011110

Discard → 100100100

Add 1 to Quotient = 00000010

Again 01000100

+11011110

Discard → 100010010

Add 1 to Quotient = 00000011

Agin 00100010

+11011110

Discard → 100000000

Add 1 to Quotient = 00000100 Ans

(h) $FC_{16} + AE_{16}$

Sol

$$\begin{array}{r} F\ C \\ +\ A\ E \\ \hline 1\ A\ A \end{array}$$

1AA Ans

(i) $F1_{16} - A6_{16}$

Sol :

Using 9's Complement

$$\frac{A}{1010} \quad \frac{6}{0110}$$

$$\begin{array}{r} 10100110 \\ +\ 01011001 \\ \hline 1 \\ \hline 01011010 \end{array}$$ 9's Complement

$$\frac{F}{1111} \quad \frac{C}{1100}$$

$$\begin{array}{r} 11111100 \\ +\ 01011010 \\ \hline 100101110 \end{array}$$

Discard → 10101110

$$\frac{0101}{5} \quad \frac{0110}{6}$$

56

Ans.

(j)

Sol

$6D_{16} - 3F_{16}$

Using 9's Complement

$\frac{3}{0011}\ \frac{F}{1111}$

00111111

+ 11000000

11000001 → 9's Complement

$\frac{6}{0110}\ \frac{D}{1101}$

Adding

01101101

+ 11000001

Discard → 10010110

$\frac{0010}{2}\ \frac{1110}{E}$

2E Ans

(k) 00010110 BCD + 00010101 BCD = ?16

Sol:

0001 0110

+ 0001 0101

0010 1010 → invalid due to (A)

invalid code

Q5 Apply modulo-2 to $1100_2 + 1011_2$

Sol:

```
 1101
 1011
 ----
 0111
```

Ans

Q6: Apply CRC to the data bits 10111001_2 using the generator code 1010_2 to Produce the transmitted CRC Code.

Sol:

$D = 11010011_2$

$G = 1010$

$D' = 11010011\,0000$

using module-2 operation

$\frac{D'}{G} = \frac{11010011\,0000}{1010}$

```
1110
1010
----
1000
1010
----
1011
1011
----
1000
1010
----
 100   <- No - Zero
```

Again by adding zero number to Data bits

```
11010011 0100
1010
----
1110
1010
----
1000
1010
----
1011
1010
----
1010
1010
----
   0
```

hence $11010011\,0100$ is Transmitted CRC

Ans

Q7 Assum
Problem
transmi
error.

Sol:

Using

(c)

$1100_{(2)} \times 11_{(2)}$

Sol:

```
   x11
    1100
   ----
    00
   00
  ·111
  ----
  100100        Ans
```

(d) $1100_{(2)} \div 10_{(2)}$

Sol:

```
      110
   ----
10 ) 1100
     10
     ---
      100
      10
      ---
       00
       00
       --
        x      (110) Ans
```

(e)

$01111111_{(2)} - 00000111_{(2)}$

Sol: Taking 2's Complement

```
  00000111
+ 11111000
  --------
         1   2's Complement
  --------
  11111001   2's Complement
```

Now

```
  01111111
+ 11111001
  --------
 101111000
```

Discard b.t

$01111000_{(2)}$ Ans

Q5 Apply modulo-2 to $1100_2 + 1011_2$.

Sol:

```
 1101
 1011
 ----
 0111
```

Ans

Q6: Apply CRC to the data bits 10110001_2 using the generator Code 1010_2 to Produce the transmitted CRC Code.

Sol:

$D = 11010011_2$

$G = 1010$

$D' = 11010011\,0000$

using module-2 operation

$\frac{D'}{G} = 11010011\,0000$ / 1010

```
1110
1010
----
1000
1010
----
1011
1011
----
1000
1010
----
100   ← No - Zeros
```

Again by adding zeros to Data bits

```
11010011 0100
1010
----
1110
1010
----
1000
1010
----
1011
1010
----
1010
```

Q7 Assume that the code produced in Problem Q6 incurs an error in the transmission APPLY CRC to detect the error.

Sol: Received dat = D' = 01011011010

B = 1010

Using modulo 2 Operation

```
01011011010
1010
----
1111
1010
----
1010
1010
----
 0110
 1010
 ----
 1100
 1010
 ----
 1101
 1010
 ----
 1110
 1010
 ----
 1000
 1010
 ----
   10 → 70
```

hence error has occured

Q7 Assume that the code produced in Problem Q6 incurs an error in transmission APPLY CRC to detect the error.

Sol: Recieved dat = D' = 01010011010

B = 1010

Using modulo 2 Epoch

01010011010
1010
1111
1010
1010
1010
0110
1010
1100
1010
1101
1010
1110
1010